Bioaccumulation of Selenium in the Food Chain

Grades

4-6

Subjects

Science and Health

Duration

20 – 30 minutes

Materials

- Small squares of paper (white and yellow)
  - 20 pieces of white paper per "grasshopper"
  - 10 pieces of yellow paper per "grasshopper"
- Access to the Internet - visit the following site to obtain a selenium fact sheet:
  - www.state.id.us/dhw/behs/index.htm - click on "fact sheets" and then click on "Health Effects of Selenium"
- Paper bags for all grasshoppers

Objective

The students will increase their understanding of how the food chain/web functions.

The students will understand how toxins can accumulate through the food chain.

The students will understand how they can be exposed to toxins by consuming other animals and plants which have been exposed to toxins.

The students will be able to obtain information from a government fact sheet.

Set

Review of the food chain/web. This is an excellent closure activity for the concept of the food chain/web.

Instructional Input

Break down students into groups of animals. Note: the following grouping assumes a class size of 26. Adjust your groups accordingly.

18 grass hoppers (9 per hawk)
6 lizards (3 per hawk)
2 hawks

Distribute the white and colored pieces of paper (food) on the floor and give the paper bags to the "grasshoppers." The pieces of paper represent plants (producer).

Instruct the "grasshoppers" to collect as many pieces of paper as they can. Tell them not to worry about whether they collect white or colored paper. The idea is for them to collect as much food as possible or they will starve. Allow the students 30-45 seconds to collect as much "food" as they can, placing it in their paper bags.

The "lizards" will prey on the lower order consumers, thereby collecting their food. Allow only 5-10 seconds for the lizards to prey upon the grasshoppers. If a lizard touches a grasshopper on the shoulder, that grasshopper has been consumed and must surrender their food bag to the lizard. Lizards with fewer than 2 grasshopper bags starve and die.

Finally, allow the hawks to prey upon the lizards in the same manner the lizards preyed upon the grasshoppers. Allow only 5 seconds for the hawks to predate. If a hawk has less than 2 bags, they starve and die.

Now, read the following scenario:

While feeding on plants, grasshoppers consumed plants which grew in soils with large amounts of the element selenium. Selenium is a naturally occurring element essential for many living creatures. However, too much selenium can cause animals to become unhealthy. The colored pieces of paper in this exercise represent plants high in selenium. Any grasshopper with 10 or more high selenium pieces of food will be unhealthy for grasshoppers to eat. Any lizard that has 25 or more high selenium pieces of food will become sick. Any hawk with 40 or more pieces of selenium will lose their appetite, will stop drinking water, and suffer from paralysis.

This example is an extreme case of what scientists call bioaccumulation. Bioaccumulation occurs when plants or animals are exposed to toxins in the environment. Consumers, or predators then eat these animals and plants. As the food is digested, the toxins are absorbed into the system of the animal eating the contaminated food. Since each successive predator must eat a certain number of prey, the toxins start to accumulate more in the predators. Higher order predators are exposed to the greatest amounts of toxins because their prey has accumulated the toxins and the predator must eat a sufficient number of prey. So, if a hawk eats 3 lizards which have 30 units of toxins each, the hawk now has 90 units of toxins. Even if an area has low levels of toxins, the higher order predators can still become sick because those toxins can concentrate in their prey. Higher order predators must consume a large amount of food. If this food is contaminated, those contaminants can build up in dangerous amounts in the predator's body.

The same holds true for humans. Imagine that elk, sheep, or deer were feeding on contaminated vegetation. Humans, preying on the elk, sheep, or deer could be exposed to unhealthy levels of selenium.

Closure

Share the *Health Effects of Selenium* fact sheet from the Idaho Division of Health, Bureau of Environmental Health and Safety website with the class. You can read the whole thing or certain sections, or read it as a class.

Ask the class to write a brief essay (5 minutes) about how they think bioaccumulation of toxins can affect human health. Challenge them to come up with an example of their own using a contaminant of their choice and their understanding of food chains/webs.